

Introduction to Aerospace Systems Concepts and Analysis Competency

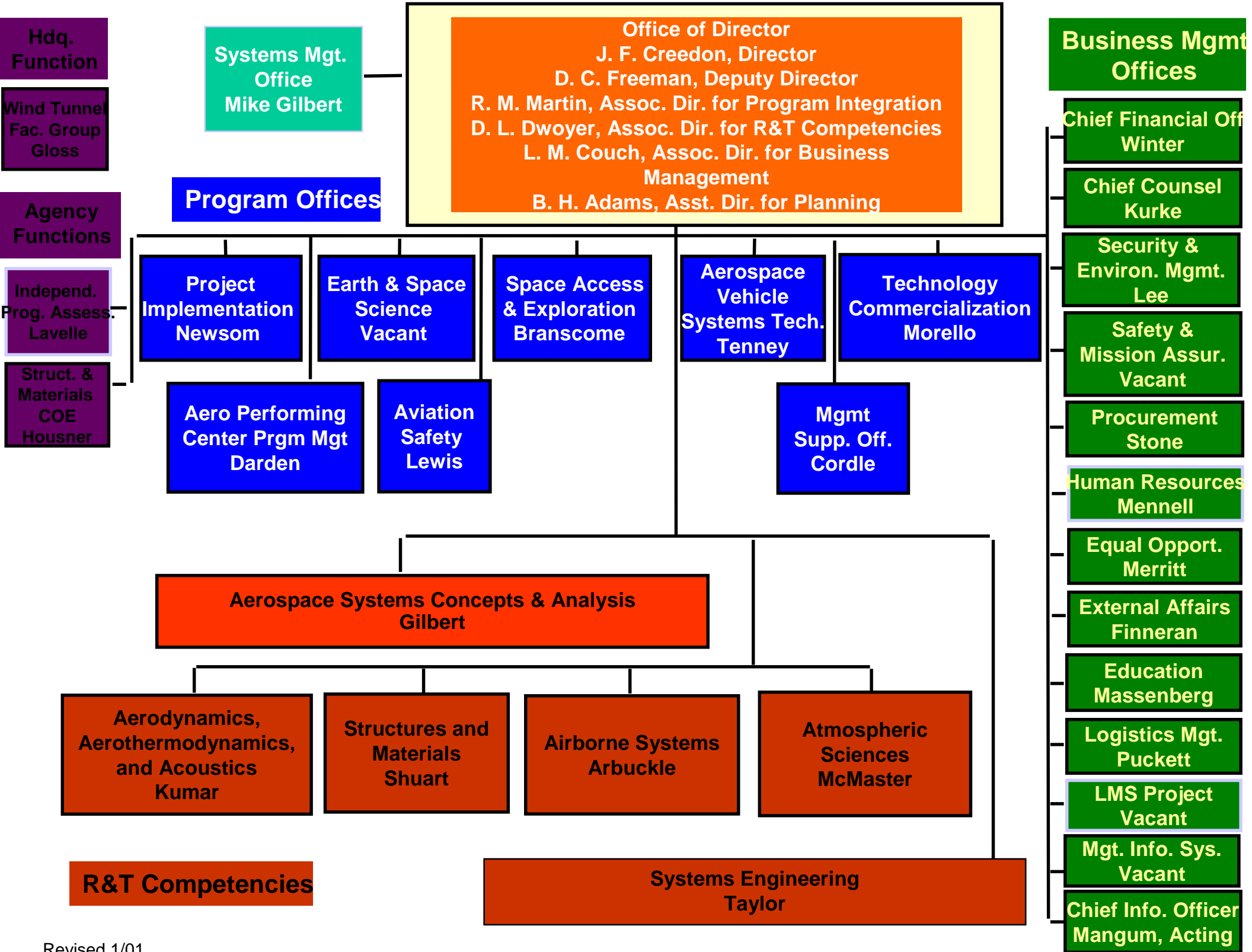
By

Bill Gilbert, Director, ASCAC

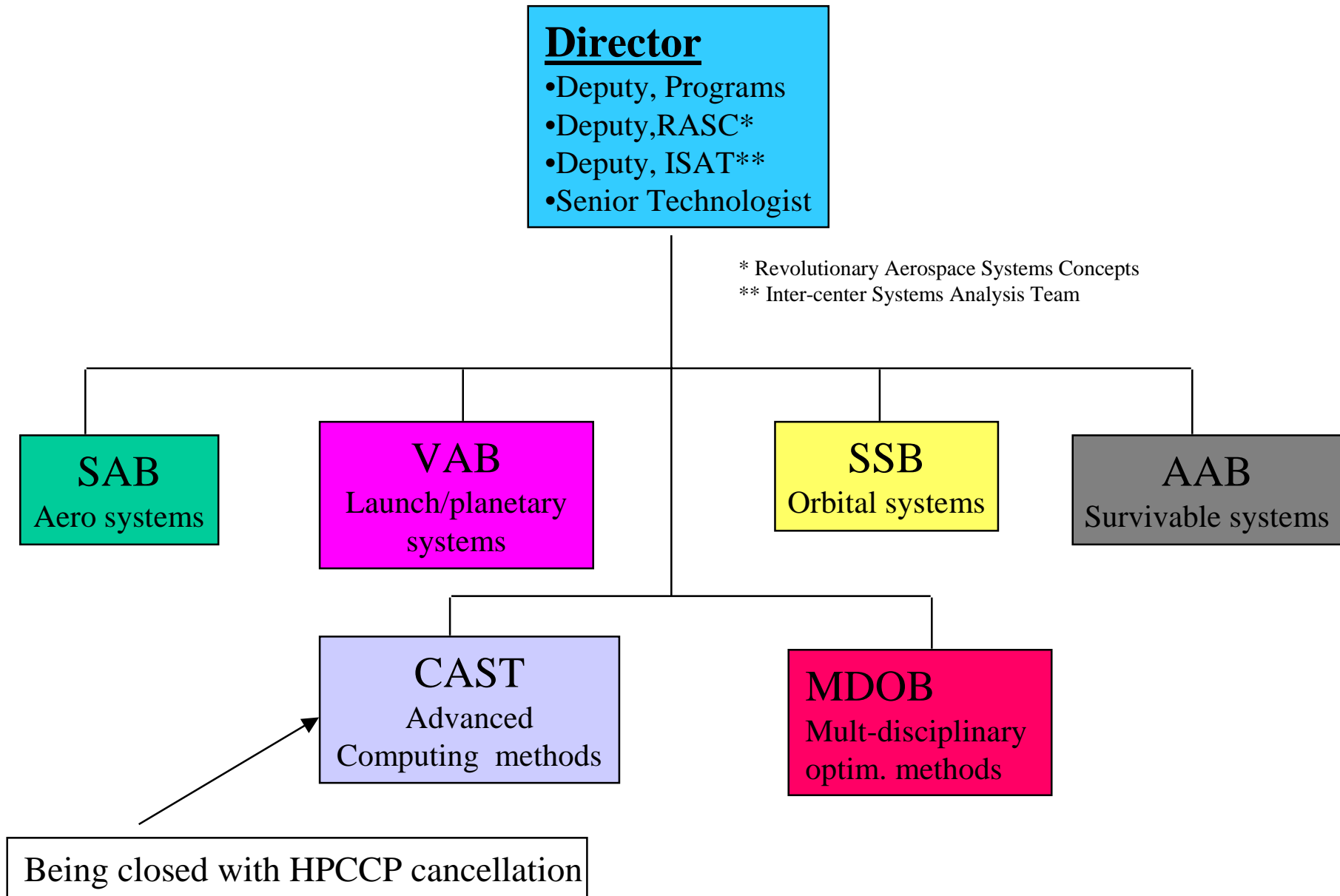
November 27, 2001

Outline

- ASCAC organization and skills
- Scope of work and approach
- Summary remarks



ASCAC Organization Plan

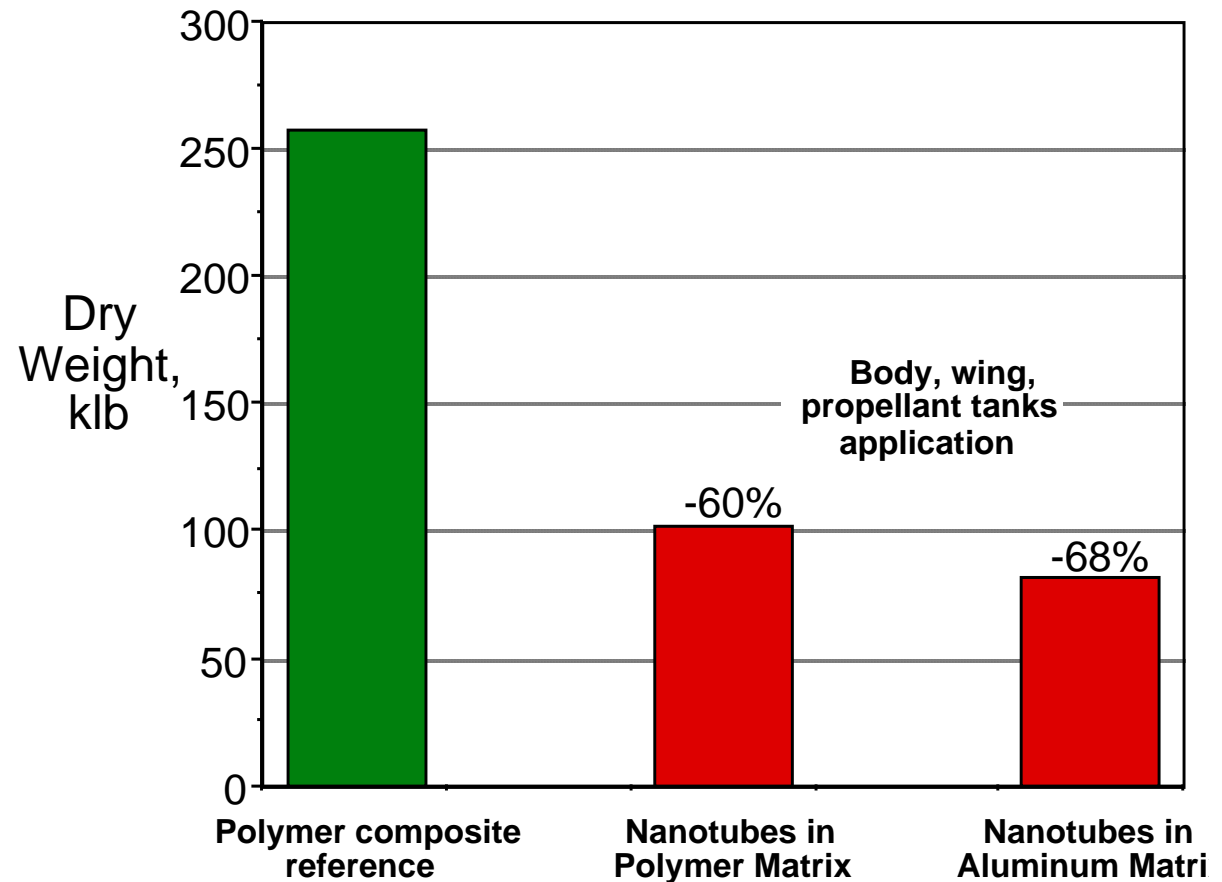


Nature of Systems Analysis Work

- Early conceptual design to preliminary design
 - Limited technology maturity and subsystem detail
- Approach
 - Technology “pull” , or capability “pull”, derived from analysis of mission needs - technology gaps
 - Examples; exploration goals, integrated aerospace transportation system, supersonic cruise without emissions/boom, etc.
 - Technology “push” derived from exploring impacts and new capabilities afforded by new, breakthrough technologies
 - Examples: Molecular Nanotechnology, smart materials
- Scope
 - Feasibility
 - Program assessments against goals
 - Technology evaluations
 - Maintain proper tools and methods

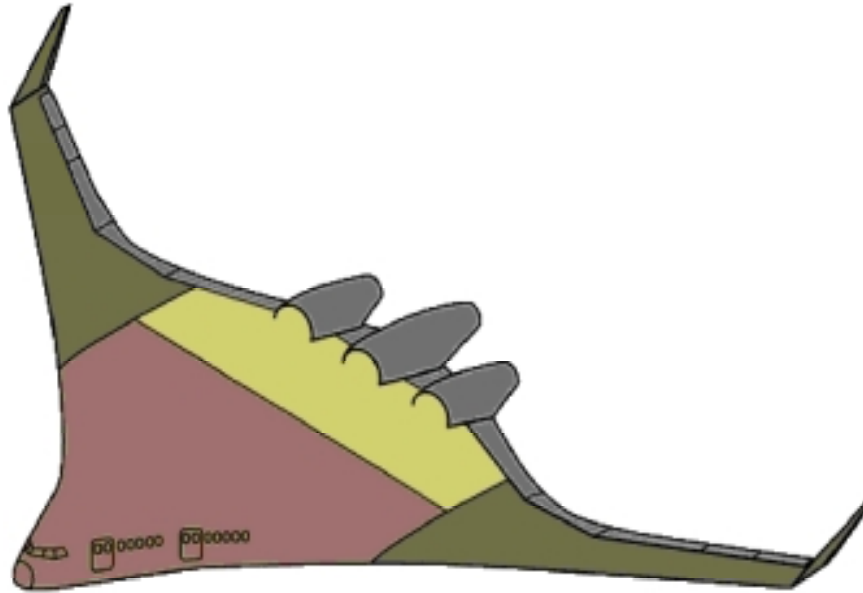
SSTO Systems Analysis Results

Results for Nanotube-Reinforced Polymer (CNTFRP) and Nanotube-Reinforced Aluminum (CNT/Al) Composites compared to an advanced carbon fiber reinforced polymer (IM7 CFRP) composite



Results: Total gross weight is reduced by over 50% relative to the best available composite material under development.

Potential Benefit of Nanotube Composites for the BLENDED WING BODY, ADVANCED LONG-RANGE TRANSPORT CONCEPT



- * Simple application of Carbon Nanotube materials cuts the empty weight of the vehicle by 45% and design fuel required by 25%
- * Application of carbon nanotube materials to an electric fuel cell BWB requires less than a factor of 2 improvement in specific power for a feasible concept.

Aerospace Systems Concepts and Analysis

People - recognized expertise with Agency role for revolutionary aerospace concepts development and mission and systems analysis

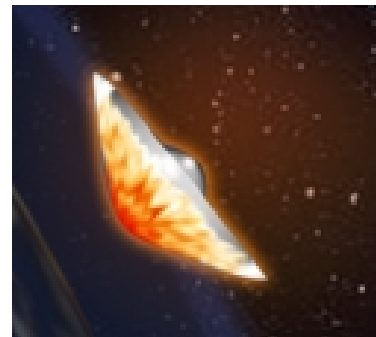
Capability - analysis capability to perform vehicle concept, mission, and systems analysis for earth and planetary entry and flight



Air Transportation



Space Launch
Initiative

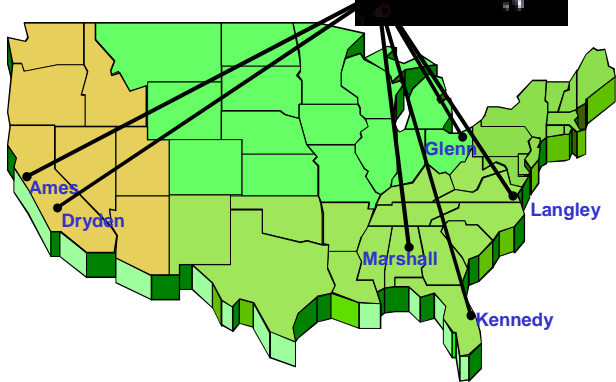
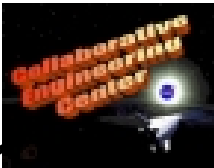


Planetary
Entry



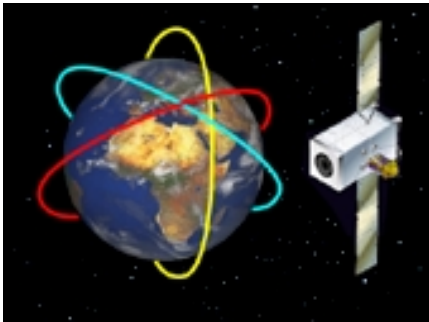
Mars Airplane

Enterprise Intercenter
Systems Analysis Team

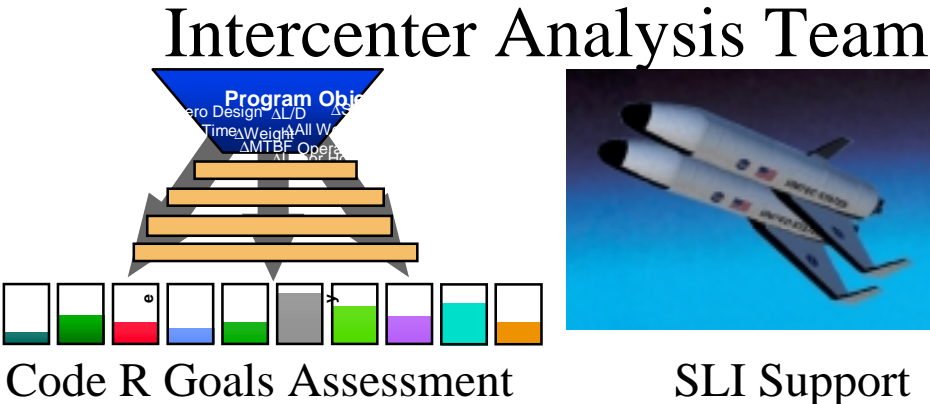


ASCAC

Revolutionary Aerospace
Systems Concepts



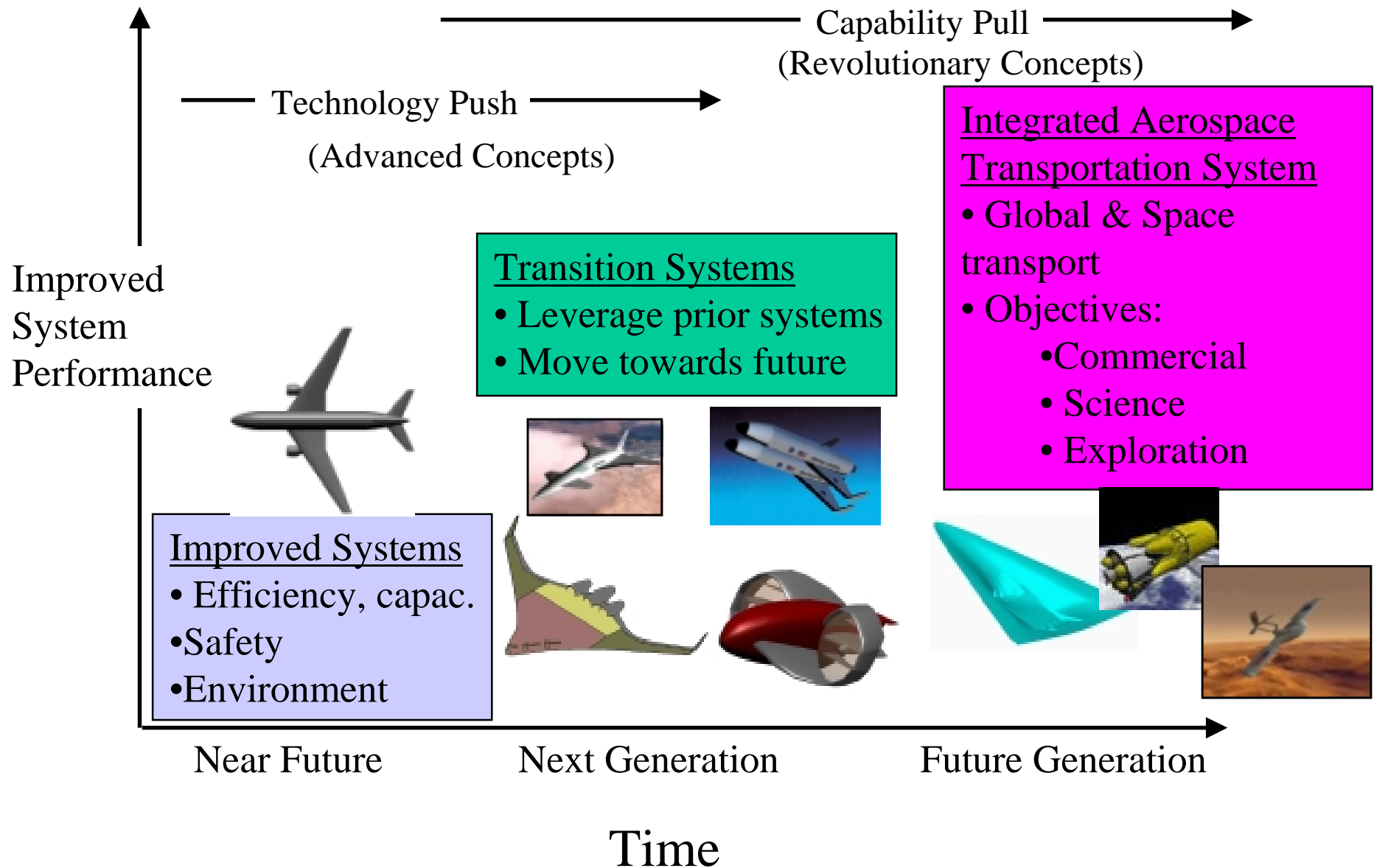
Exploration Planning



SLI Support

Need a Balanced Systems Approach - Near and Far Term Needs

- improved...advanced....revolutionary -



AEROSPACE SYSTEMS, CONCEPTS & ANALYSIS

ORBITER EXPRESS

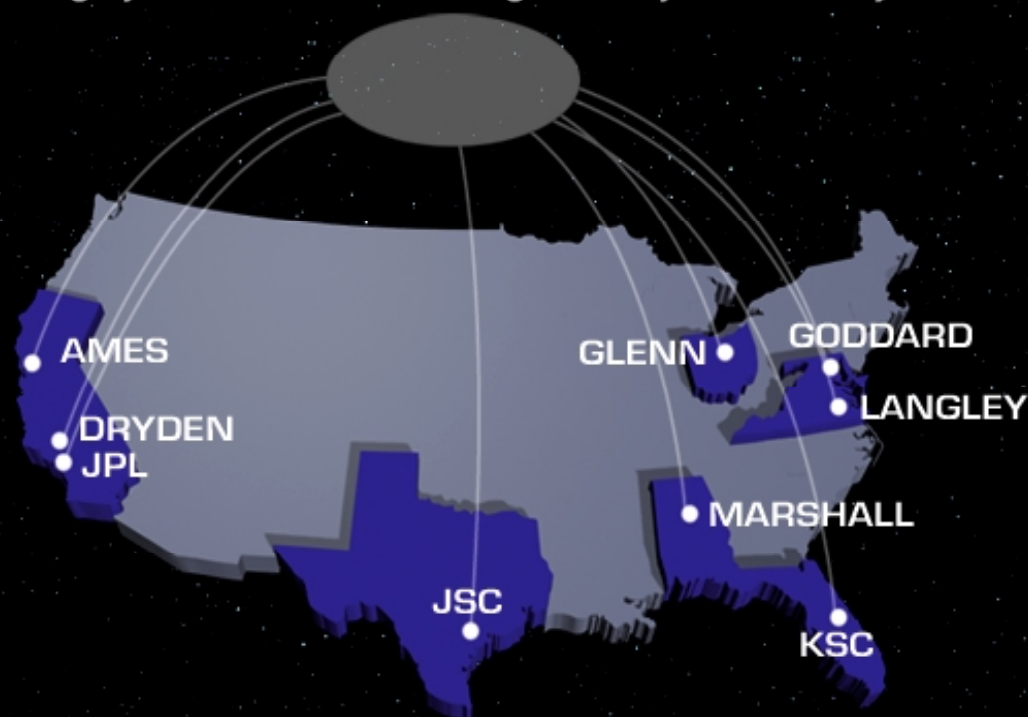


PLANETARY RE-ENTRY



MARS AIRPLANE

Langley-Led NASA-Wide Integrated Systems Analysis



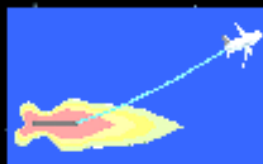
SLI



3RD GEN



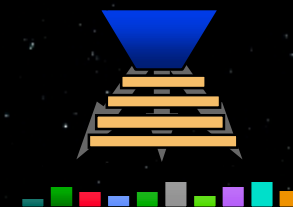
QAT

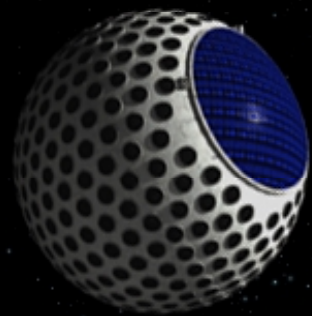


21ST CENTURY WING



ISAT

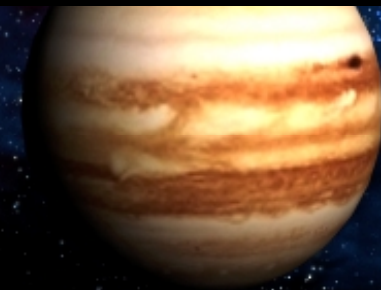




CAPS



HPM



EUROPA
EXPLORATION

CURRENT RASC STUDIES



HUMAN & ROBOT
EXPLORATION

CODE Y



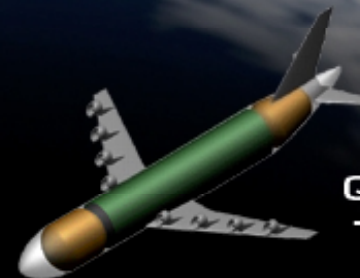
SUPERSONIC
BUSINESS JET



PAVE



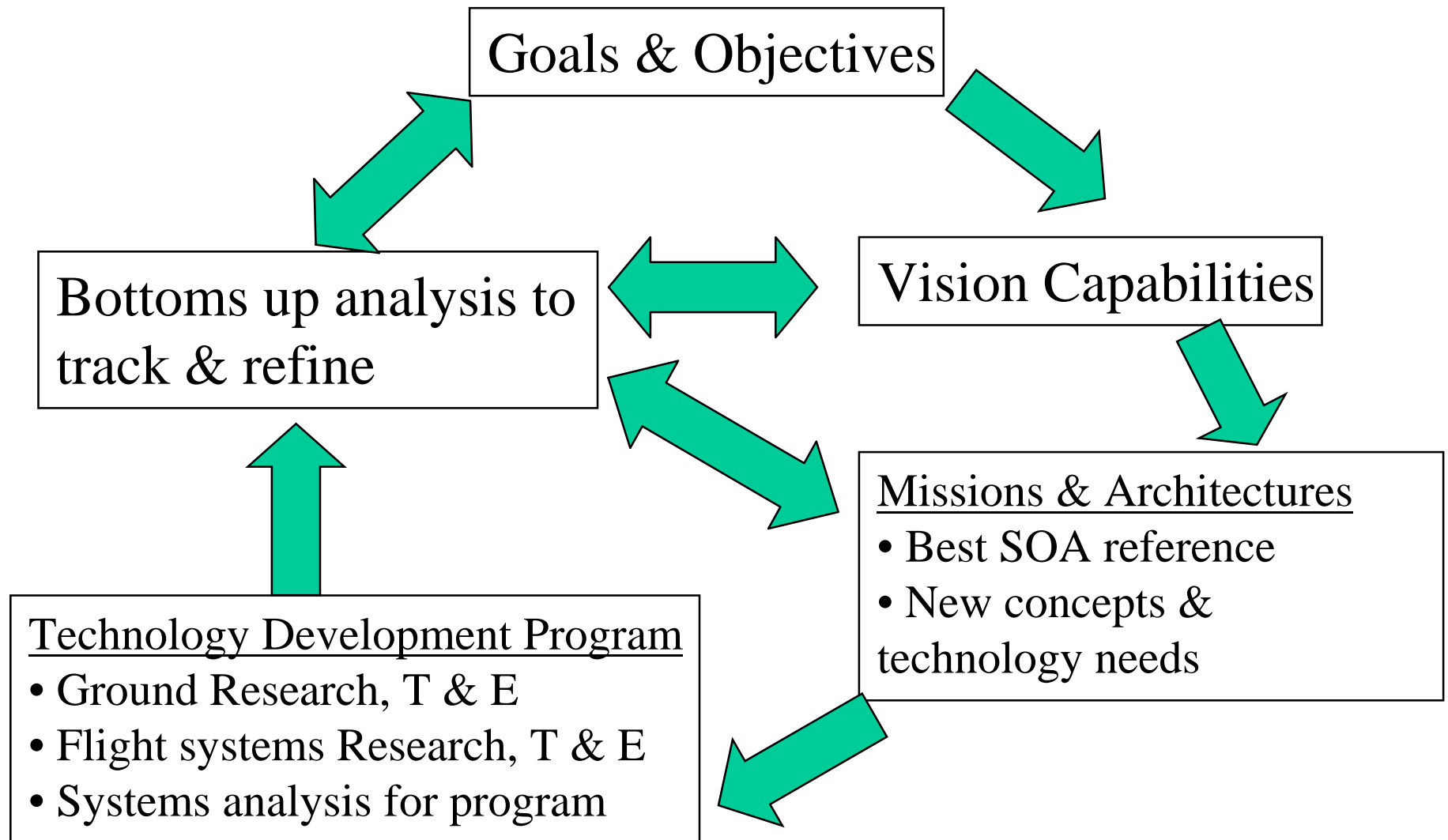
CONCEPT 1
AEROSPACE
VEHICLE



QUIET GREEN
TRANSPORT

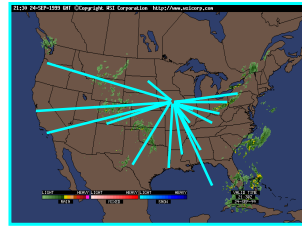
Systems Analysis for Programs

(Top down; bottoms up)

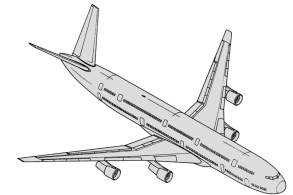
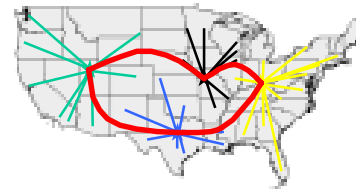


Air Transportation Architecture Generations

Generation 1 - Today's Hub and Spoke System

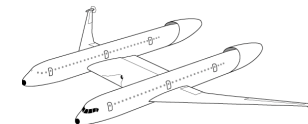
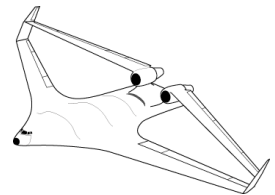
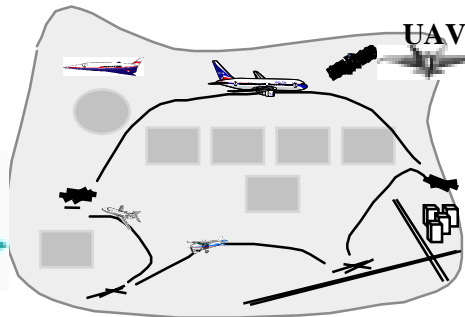
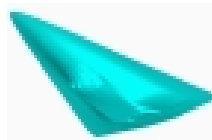


Generation 2 - Super Hub and Spoke with variations



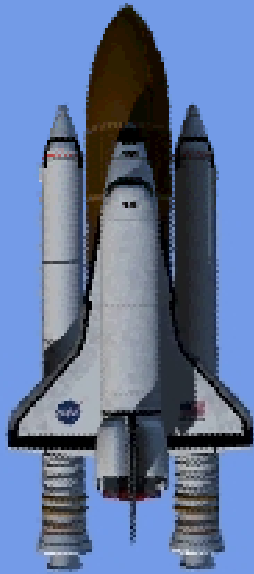
2009 Technology

Generation 3 - New paradigm - distributed

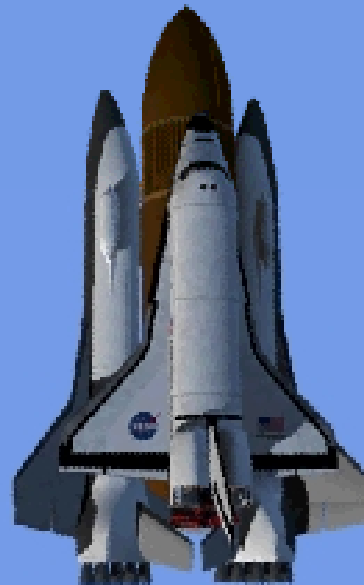


ISAT Space Transportation Reference Vehicles

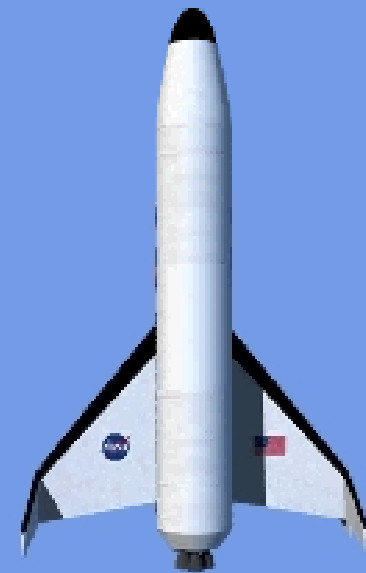
- Working to add on-orbit elements to these -



STS Upgrade



Shuttle Derived



Single Stage to Orbit



**Two Stage to Orbit
(Bimese)**



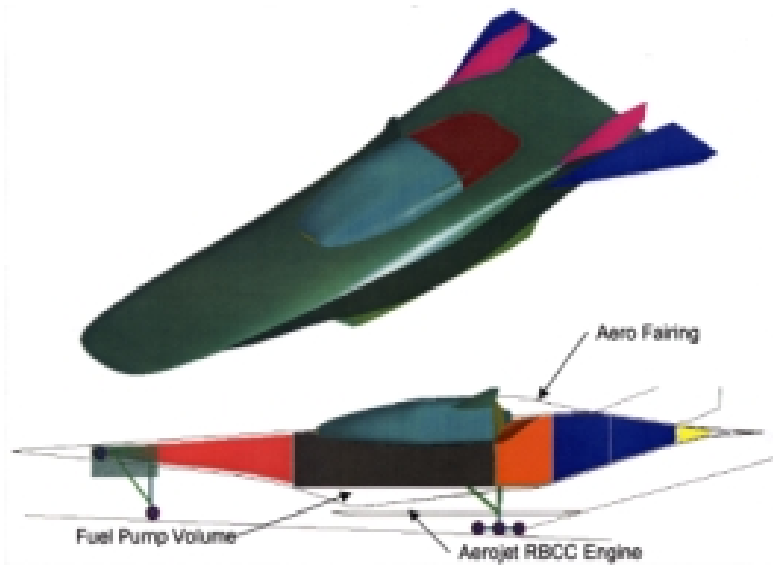
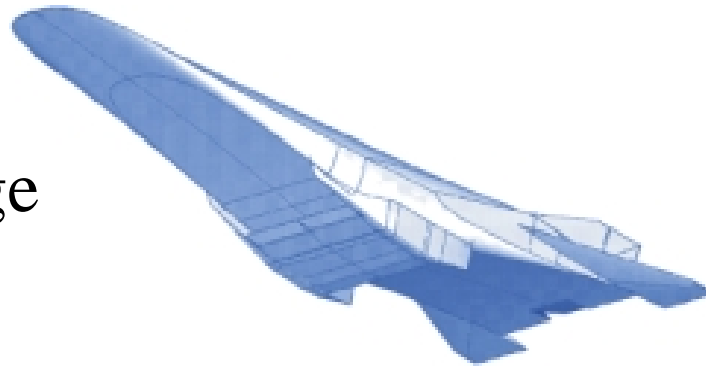
**Crew Transfer
Vehicle**

ISAT Space Transportation Reference

Vehicles

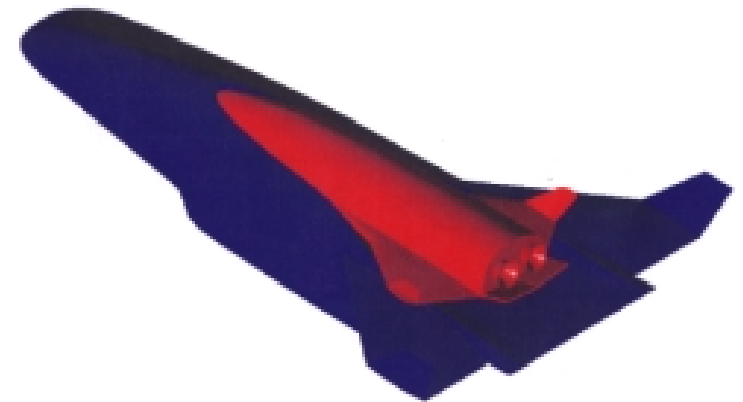
- 3rd Gen RLV -

Single Stage



Hydrogen-fueled

Two Stage



HC fueled

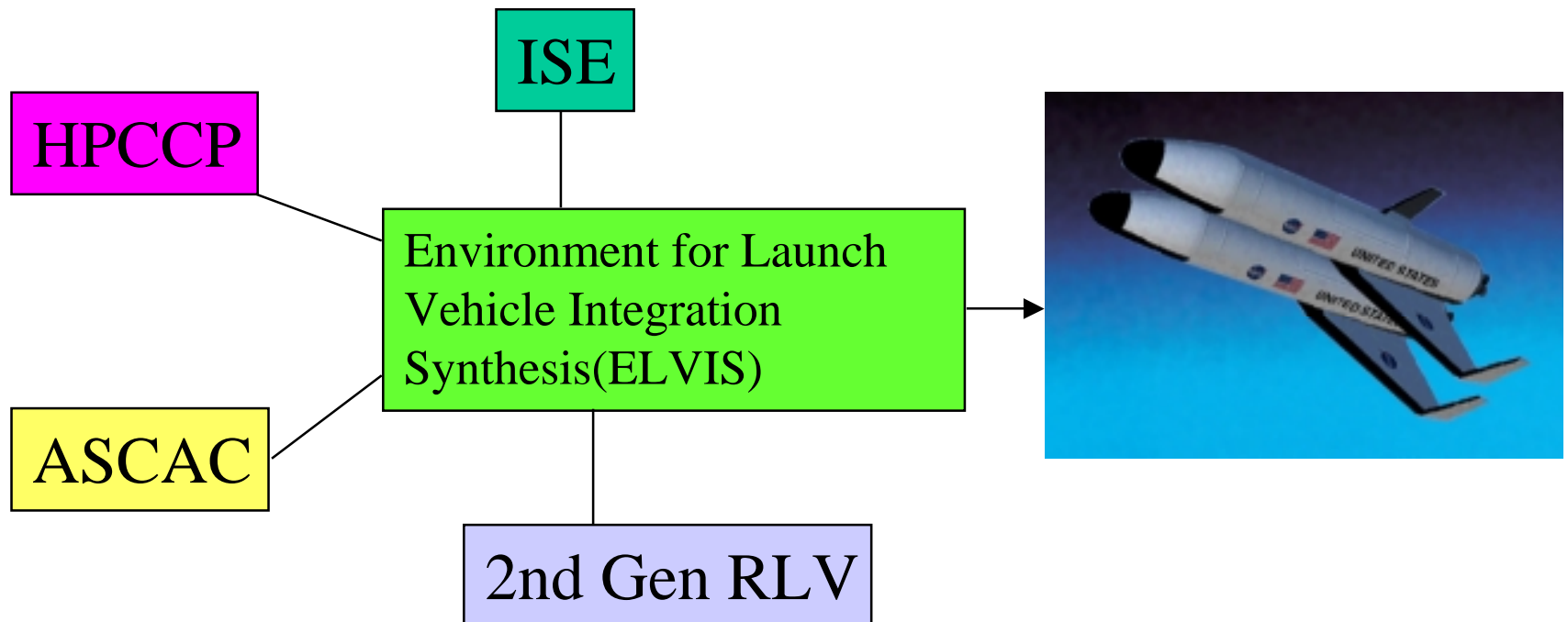
Summary Remarks

- Our success is critically dependent on our systems analysis methods and analysis frameworks- **aeronautics and space systems**
- We need methods for conceptual design and technology trades on advanced concepts
 - Versatile (diverse configurations, technologies)
 - Variable fidelity
 - Fast & agile
 - Accurate discipline coupling & consistent results
 - Developed in partnership with users
 - Give balanced(optimum) solutions for performance, cost, risk/safety
- How we are doing ?
 - Quality, results, relevance,skill mix
 - Do we have a critical mass
 - How do we compare to others working this area

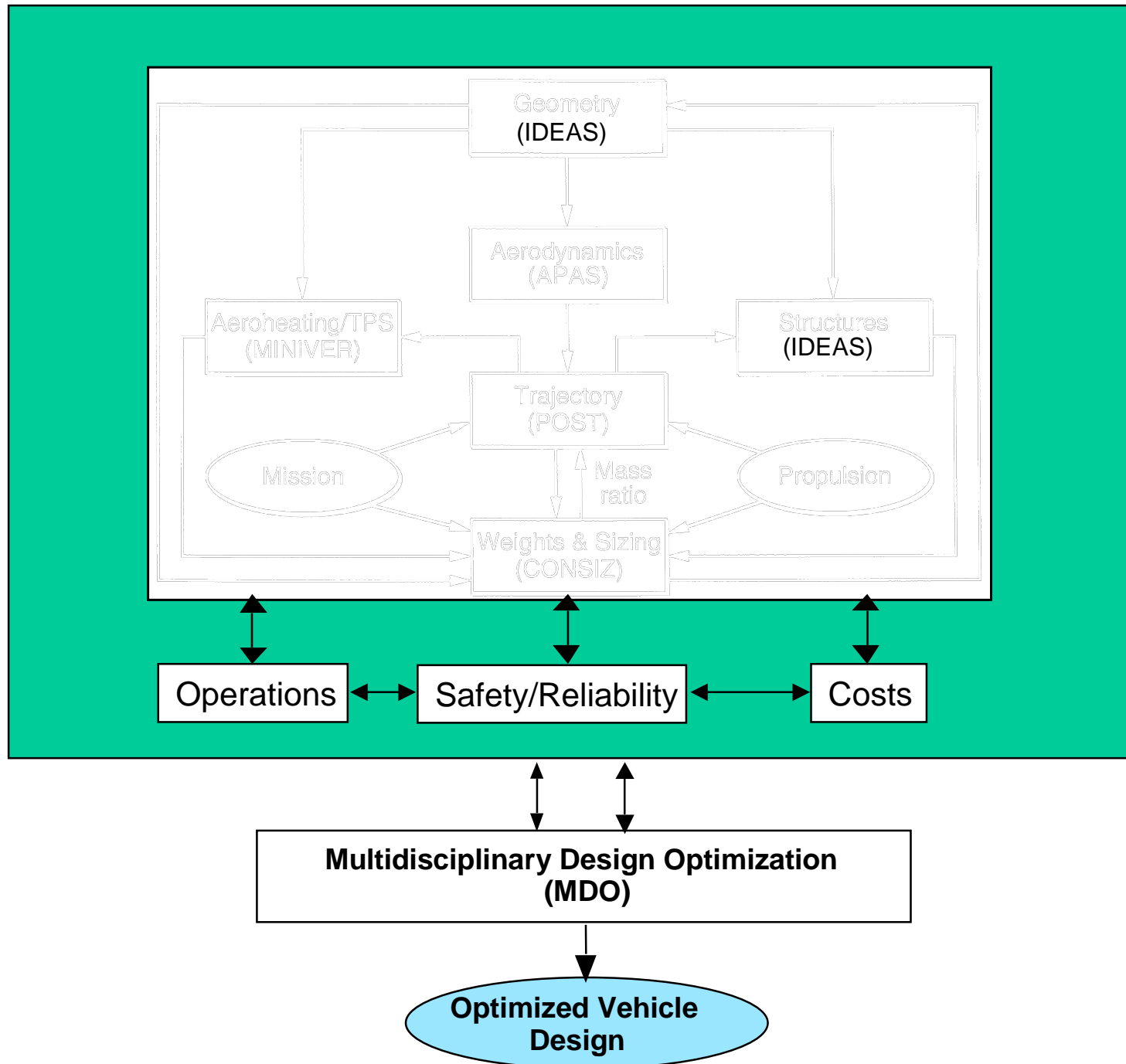
Advanced Systems Analysis/Optimization Methods

Objectives

- Improve fidelity and integration
- Balance performance, cost, safety/risk
- Use multidiscipline optimization framework
- Shorten analysis/optimization cycles
- Cooperative team formed recently developing improved analysis framework in support of 2nd Generation RLV Program



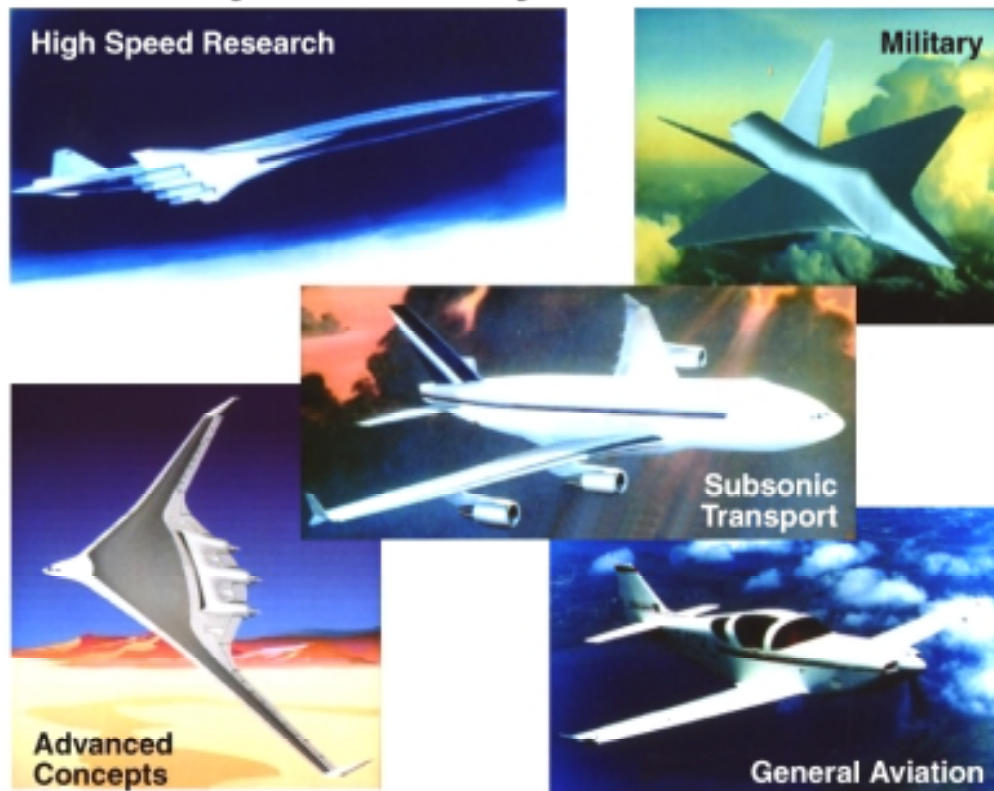
Systems Analysis for Launch Vehicles





Advanced Civil Airplane & Transportation Systems Analysis

Aircraft Systems Analysis



Transportation Systems Analysis



Aeronautics Systems Analysis Tools

Aircraft Synthesis and Optimization (FLOPS)/(ACSYNT)
Aviation System Analysis Capability (ASAC)
Aircraft Life Cycle Cost Analysis (ALCCA)
NASA Cost Benefit Analysis (NACBA) Tool

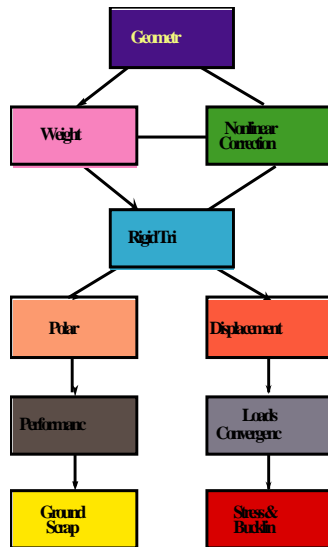




MultiDisciplinary Optimization Branch

MD Integration

Geometry Models
Integration Tools

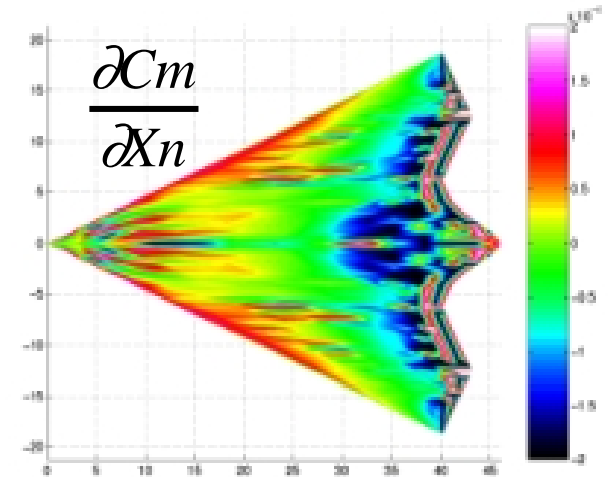


Charter

Develop MDO methods to
increase confidence and
cut development time

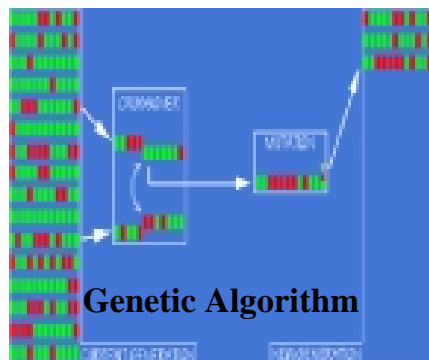
Design-Oriented Analysis

Approximations
Sensitivity Analysis



MD Optimization

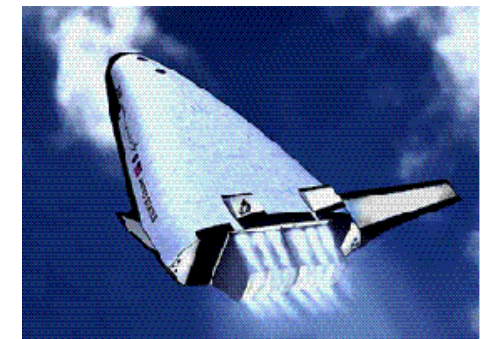
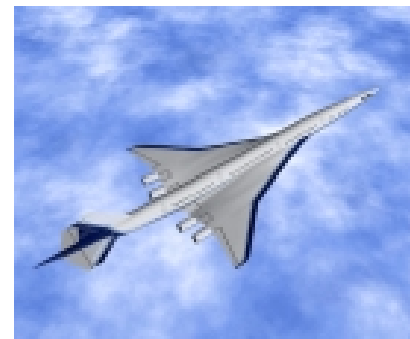
Formulations
Algorithms



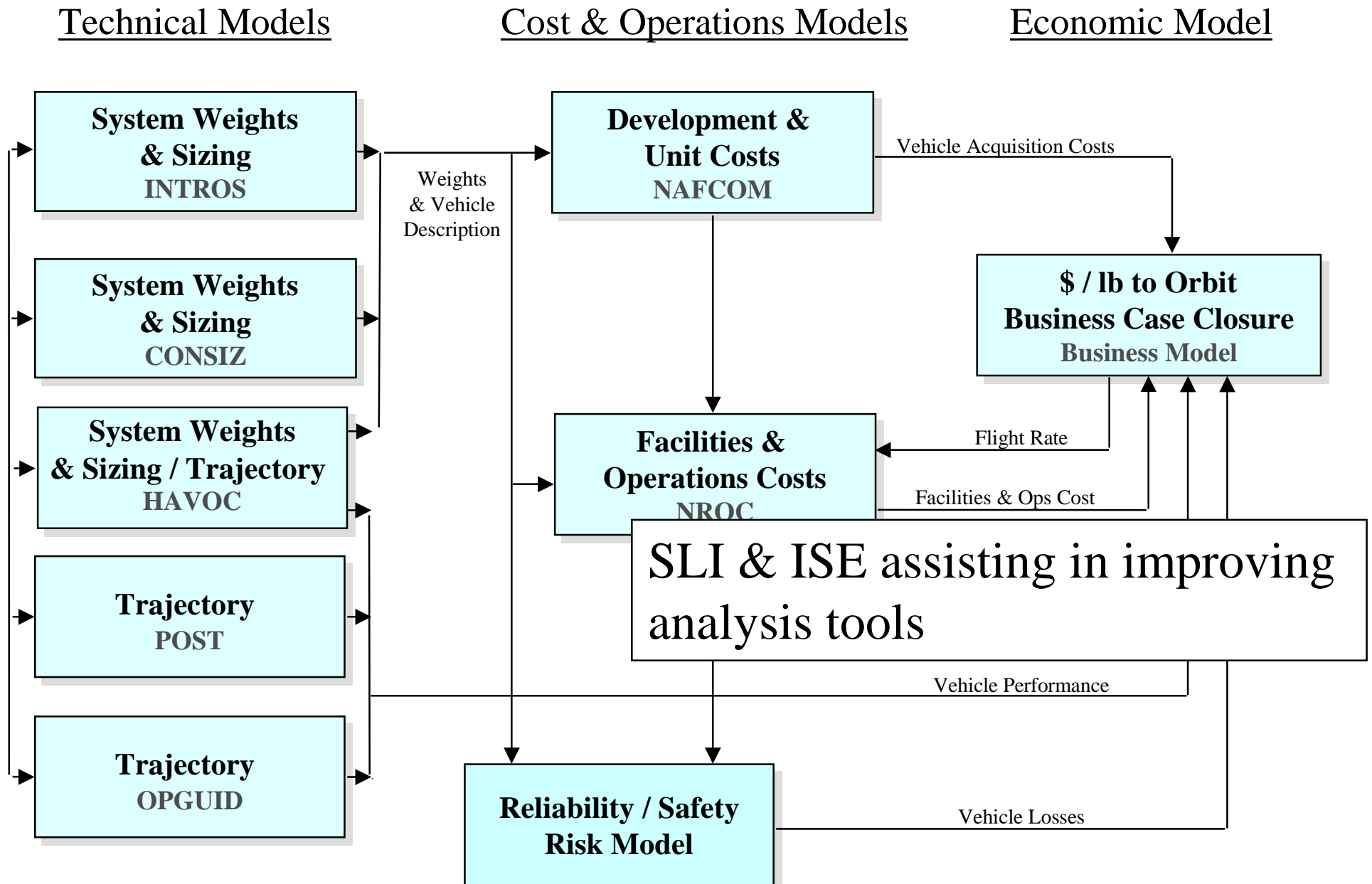
High-Fidelity Applications

Aeronautics

Space



RSTS/AEE Integrated Analysis Tools



Tools Used In Aviation Systems Analysis

Aircraft Models

ACSYNT

FLOPS

NEPP

NPSS

Discipline
models



Safety Models

ASAFE

BSAFERR



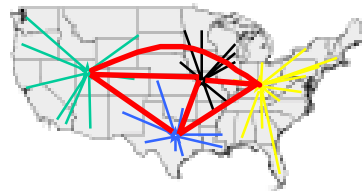
Need partnership with AvSTAR
in improving our aviation airspace
analysis tools

Airport - Airspace Models

ASAC

TAAM

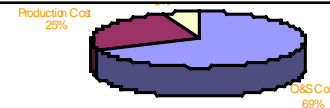
Other



ALCCA

TCM

COSTRAN



Decision Tools

@RISK

TIES

Crystal Ball

